भारतीय मानक

नलिकाकार प्रतिदीप्ति लैम्पों तथा डिस्चार्ज लैम्प परिपथों के लिए संधारित्र

भाग 2 कार्यकारिता अपेक्षाएँ

Indian Standard

CAPACITORS FOR USE IN TUBULAR FLUORESCENT AND OTHER DISCHARGE LAMP CIRCUITS

PART 2 PERFORMANCE REQUIREMENTS

ICS 29.140.30

© BIS 2013

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 2013 **Price Group 3**

Electric Lamps and Their Auxiliaries Sectional Committee, ETD 23

FOREWORD

This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electric Lamps and Their Auxiliaries Sectional Committee had been approved by the Electrotechnical Division Council.

This standard specifies the requirements for both self-healing and non-self-healing continuously rated ac capacitors of up to and including 2.5 kvar, and not less than 0,1 µF, having a rated voltage not exceeding 1 000 V, which are intended for use in discharge lamp circuits operating at 50 Hz and at altitudes up to 3 000 m.

This standard covers only performance requirements. Safety requirements are covered in Part 1 of this standard. The capacitors on which compliance with this standard is claimed shall also require complying with the Part 1 of this standard.

This standard is based on IEC 61049 : 1991 ‘Capacitors for use in tubular fluorescent and other discharge lamp circuits — Performance requirements’ issued by the International Electrotechnical Commission (IEC).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CAPACITORS FOR USE IN TUBULAR FLUORESCENT AND OTHER DISCHARGE LAMP CIRCUITS

PART 2 PERFORMANCE REQUIREMENTS

1 SCOPE

This standard (Part 2) specifies the requirements for both self-healing and non-self-healing continuously rated ac capacitors of up to and including 2.5 kvar, and not less than 0.1 µF, having a rated voltage not exceeding 1 000 V, which are intended for use in discharge lamp circuits operating at 50 Hz and at altitudes up to 3 000 m.

NOTE — These lamps and associated ballasts are covered in the following Indian Standards:

a) IS 2418 (Part 1) : 1977 'Tubular fluorescent lamps for general lighting service: Part 1 Requirements and tests'.
b) IS 9900 (Part 1) : 1974 'High-pressure mercury vapour lamps: Part 1 Requirements and tests'.
c) IS 1534 (Part 1) : 1977 'Ballasts for tubular fluorescent lamps: Part 1 For switch start circuits'.
d) IS 6616 : 1982 'Ballasts for high pressure mercury vapour lamps'.

It covers capacitors intended for connection in shunt or in series with the lamp circuit or an effective combination of these.

It covers only impregnated or unimpregnated capacitors, having a dielectric of paper, plastic film or a combination of both, either metallized or with metal foil electrodes.

This standard does not cover radio-interference suppressor capacitors the requirements for which are found in IS 3723 (Part 1) : 1978 'Capacitors for radio interference suppression: Part 1 General requirements and methods of tests'.

Tests in this standard are type tests. Guidance on conformity of production is given in Annex A.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
2500 (Part 1) : 2000	Sampling inspection procedures: Part 1 Attribute sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection (*third revision*)
3723 (Part 1) : 1978	Specification for capacitors for radio interference suppression: Part 1 General requirements and methods of tests (*first revision*)
9000 (Part 14/ Sec 1 to 9) : 1988	Basic environmental testing procedures for electronic and electrical items: Part 14 Test N: Change of temperature
15967 (Part 1) : 2010	Capacitors for use in tubular fluorescent and other discharge lamp circuits: Part 1 Safety requirements

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 15967 (Part 1) shall apply.

4 GENERAL NOTES ON TESTS

All capacitors specified in this standard shall comply with the requirements of IS 15967 (Part 1).

Tests according to this standard are type tests.

Capacitors shall be subjected to the tests detailed in **5**. Unless otherwise specified, tests shall be carried out at a temperature of 20 ± 5°C, using where appropriate a voltage source as detailed in Annex B.

Test temperatures specified in particular clauses shall be subject to a tolerance of ± 2°C, unless otherwise stated.

Unless otherwise specified, the type shall be deemed to comply with any one clause, if not more than one failure occurs in the test of that clause. If three or more failures occur, the type shall be rejected. If two failures occur in any one test, that test, and any preceding tests which may have influenced the test results, shall be repeated on the same quantity of capacitors and if any further failures occur, the type shall be rejected.

For a range of capacitors of the same construction, rated voltage and cross-sectional shape, each group referred to in **5** shall contain as nearly as possible equal numbers of capacitors of the highest capacitance and the lowest capacitance in that range.

Moreover, the manufacturer shall provide data on the ratio of capacitance per area outer total surface of the container of each capacitance value in the range.

The capacitor with the maximum capacitance per unit surface area shall also be tested, if this ratio exceeds that of the maximum capacitance value in the range by 10 percent or greater. Similarly, the capacitor with the minimum capacitance per unit area shall also be tested, if the ratio is less than that of the minimum capacitance value in the range by 10 percent or greater.

Area denotes total outer surface area of capacitor case ignoring small protrusions, terminals and fixing studs.

With this procedure the tests qualify all intermediate values of capacitance in the range.

NOTES

1 The requirements and tolerances permitted by this standard are related to testing of a type test sample submitted for that purpose. In principle, this type test sample should consist of units having characteristics typical of the manufacturer's production and be as close to the production centre points as possible.

2 It may be expected with the tolerances given in the standard that products manufactured in accordance with the type test sample shall comply with the standard for the majority of the production. Due to the production spread, it is inevitable, however, that there may be products outside the specified tolerances. For guidance on sampling plans and procedures for inspection by attributes [*see* IS 2500 (Part 1)].

3 The same construction includes for example the same dielectric material, dielectric thickness and type of case (metal or plastic).

4 Cross-sectional shape means: round, rectangular, oval, etc.

5 TESTING SEQUENCE

A total of 47 non-self-healing capacitors, or in the case of self-healing types 52 capacitors, shall be taken and divided into four groups as indicated below.

The following initial test shall be applied to all the capacitors:

— capacitance measurement in accordance with **7**.

The first group of 5 capacitors shall be subjected to the test for deviation of capacitance with temperature in accordance with **8**.

The second group of 5 capacitors, completed with the 5 capacitors of the first group, shall be subjected to the self-healing test in accordance with **9**. This test is only applicable for self-healing capacitors.

The third group of 21 capacitors shall be subjected to the endurance test in accordance with **9**.

The fourth group of 21 capacitors shall be retained as spares in the event of a repeat test being necessary in the first three groups.

NOTE — For capacitors above 1 kvar the quantities for testing can be agreed between manufacturer and testing authority.

6 MARKING

The marking requirements of IS 15967 (Part 1) shall apply, together with the following.

6.1 Period of manufacture, which may be in code form.

6.2 For unimpregnated metallized plastic film shunt capacitors of 250 V rated voltage or less, with a t_c not higher than 85°C, the letter 'D'.

6.3 BIS Certification Marking

The capacitors may also be marked with the Standard Mark.

6.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 CAPACITANCE

The capacitance of each capacitor when measured at 50 Hz, as appropriate, shall be within the tolerance limits marked on the capacitor.

Capacitance shall be measured using a method which excludes errors due to harmonics. The accuracy of measurement shall be better than 0.25 percent of the capacitance measured. The measuring voltage shall not be higher than the rated voltage of the capacitor; the frequency shall be as near as possible to the rated frequency.

Measurement at other frequencies is allowed, provided that the frequency dependence of the capacitance is very small. The measured capacitance shall not deviate from the rated capacitance by more than the tolerance marked on the capacitor.

Compliance is checked by measurement.

8 CHANGE OF CAPACITANCE WITH TEMPERATURE

The change of capacitance with temperature shall stay within acceptable limits.

Compliance is checked by the tests of **8.1** to **8.6**.

8.1 Measurements of capacitance shall be made under the conditions prescribed in **7**.

8.2 The capacitor shall be measured at each of the following temperatures in turn:

a) 20 ± 2°C;

b) Rated minimum temperature : ± 3°C ($C_{\mathrm{T\,Min}}$);
c) 20 ± 2°C;
d) Rated maximum temperature : ± 2°C ($C_{\mathrm{T\,Max}}$); and
e) 20 ± 2°C.

8.3 Capacitance measurements shall be made at each of the temperatures specified in **8.2** after the capacitor has reached thermal stability. The measuring voltage shall be applied only for the minimum time necessary to make the capacitance measurements.

The condition of thermal stability shall be judged to have been reached when two readings of capacitance taken at an interval of not less than 5 min do not differ by an amount greater than that which can be attributed to the measuring apparatus.

The actual temperature of measurements shall be measured to an accuracy of ± 0.2°C.

Care should be taken during measurements to avoid condensation or frost on the surface of the capacitors.

8.4 The change of capacitance with temperature shall be calculated as follows:

$$\frac{C_{\mathrm{T\,Min}} - C_0}{C_0} \times 100 \text{ for the rated minimum temperature;}$$

$$\frac{C_{\mathrm{T\,Max}} - C_0}{C_0} \times 100 \text{ for the rated maximum temperature;}$$

where

C_0 = capacitance measured at the temperature specified in **8.2** (c);

$C_{\mathrm{T\,Min}}$ = capacitance measured at the temperature specified in **8.2** (b) (rated minimum temperature);

$C_{\mathrm{T\,Max}}$ = capacitance measured at the temperature specified in **8.2** (d) (rated maximum temperature).

8.5 The capacitance measured in accordance with **8.2** (a) and **8.2** (e) are not used in the calculation but shall be included in the test report to indicate the reproducibility of the results.

8.6 The change of capacitance with temperature shall not exceed ± 5 percent.

9 ENDURANCE TEST

Capacitors shall have an adequate life expectancy.

Compliance is checked by tests of **9.1** to **9.7**.

NOTE — The purpose of the test is to demonstrate that capacitors operating under intended conditions may be expected to have a life of at least 10 years' continuous operation.

9.1 Initial Measurements

The capacitance is measured in accordance with **7**. For the purpose of **9.5** the tangent of loss angle shall be measured under the same conditions.

9.2 Thermal Cycling

The capacitors are submitted to 10 cycles of rapid change of temperature according to IS 9000 (Part 14/Sec 1 to 9) with prescribed time of transition, or 10 cycles of Test Nb with specified rate of change. Minimum average rate of change to be 2°C per/min.

Each cycle shall consist of the following:

a) 1 h at room temperature;
b) 6 h at rated minimum temperature;
c) 1 h at room temperature; and
d) 16 h at rated maximum temperature (t_c).

An ac voltage of 1.25 U_n is applied to the terminals of the capacitors for the final hour of each of the cold periods.

9.3 Application of Voltage at Elevated Temperature

The capacitors are energized at a temperature of t_c for one of the voltages and the corresponding time given in Table 1, the choice being left to the manufacturer.

If a time longer than 2 000 h is indicated in Table 1 above, then for capacitors marked 'D' pproval is granted after 2 000 h provided that the permitted change in capacitance between initial and 2 000 h measurements is obtained by multiplying the total change specified by the ratio 2 000 to the full term hours.

Example: 8 500 h, 1.15 U_n and 10 percent permitted change in capacitance is equivalent to 2.35 percent;

That is $\frac{2000}{8\,500} \times 10$ percent = 2.35 percent at 2 000 h and 1.15 U_n

NOTE — Table 1 is based on the equivalence of the test to 30 000 h at U_n using an acceleration factor to the 9th power of the voltage ratio.

If the manufacturer wishes to claim that a different acceleration factor is appropriate to the technology he is using, then he shall carry out a series of endurance tests on a statistically relevant number of capacitors [*see* IS 2500 (Part 1) for statistical sampling] at different voltages according to **9.7**, and thus establish an alternative table to be used in place of the one above.

On mutual agreement between the test authority and the manufacturer, type approval can be given on the basis of a test report submitted by the manufacturer.

Table 1 Application of Voltage and Corresponding Time

(*Clause* 9.3)

Sl No. (1)	Voltage X U_n (2)	Time h (3)
i)	1.15	8 500
ii)	1.25	4 000
iii)	1.30	2 900
iv)	1.35	2 000
v)	1.40	1 500
vi)	1.45	1 100
vii)	1.50	780

9.4 Test Enclosure

The capacitors are mounted in an enclosure in which the temperature of the air is constant within a tolerance of ± 2°C.

The air in the enclosure is continuously agitated, but not so vigorously as to cause undue cooling of the capacitors. The capacitors under test are not subjected to direct radiation from any heating elements in the enclosure.

The sensitive element of the thermostat regulating the air temperature of the enclosure shall be well within the stream of heated circulating air.

The capacitors are mounted in a position most favourable to the leakage of impregnant or filling material. The distance between cylindrical capacitors shall be not less than their diameter, and the distance between rectangular capacitors shall be not less than twice the shorter side of their base.

The temperature sensitive element of a temperature recording instrument shall be attached half-way up the side of the case of the capacitor with the lowest value of tangent of loss angle.

The thermostat is set at $(t_c - 15)$°C, and capacitors are then energized (*see* Annex B). During the first 24 h, the difference between t_c and the indication of the temperature recording instrument is noted and adjustments made to ensure the temperature of each capacitor case is at $(t_c - 5)$°C.

The test shall then continue to the end of the appropriate time without further adjustment of the thermostat, the time being measured from the first energization of the capacitors.

NOTE — Heating of the air may take place in a separate enclosure from which the air can be admitted to the test enclosure through a valve allowing good distribution of heating air over the capacitors.

9.5 Final Measurements

After the capacitors have cooled to room temperature, the capacitance and the tangent of the loss angle are measured in accordance with **6** and using the same frequency as in **9.1**.

9.6 Conditions of Compliance

A capacitor fails, if during the test it suffers breakdown (short-circuit) or flashover, becomes open-circuited or suffers leakage of impregnant which falls away in drops. In addition the difference between initial and final capacitance measurements shall not exceed,

a) for series capacitors; 5 percent, and
b) for parallel capacitors; 10 percent

of the initial measurement or a lower percentage as may be agreed to between the purchaser and the manufacturer.

In addition to the tangent of loss angle at the end of the endurance test shall not exceed the value declared by the manufacturer.

The test is satisfied with none or one non-destructive capacitor failure and rejected with three or more capacitor failures. If two failures occur, the test is repeated on 21 new capacitors. One failure, due to change of capacitance or loss angle, is permitted.

9.7 Establishment of an Individual Acceleration Factor for a Given Technology

At least three tests are carried out according to **9.1** to **9.6** except that the times and voltages are selected by the manufacturer.

At least one test is carried out at a sufficiently low over-voltage to give a test time of at least 8 000 h.

When plotted on log-log paper and extrapolated to a voltage of 1.0 U_n the life at this voltage shall be not less than 30 000 h.

This voltage, which is the rated voltage, shall be that marked on the capacitor. In addition, using the new acceleration factor, the voltage shall be calculated which corresponds to a life of 10 years at a temperature of t_c.

The power law established by this method shall be used to construct a table similar to that in **9.3** and this shall then be used in place of that table for further testing of capacitors using this technology.

ANNEX A

(*Clause* 1)

CONFORMITY OF PRODUCTION

A-1 The tests specified in this Annex, which are offered as a guide to the manufacturer, are intended to reveal, as far as performance is concerned, unacceptable variations in material or manufacture.

Clause 8

Without change.

Clause 9

In order to assure conformity of production the manufacturer should carry out a test annually in accordance with **9**. If an individual acceleration factor has been proved in accordance with **9.7** this may be used for determining the test time.

ANNEX B

(*Clauses* 4 *and* 9.4)

TEST VOLTAGE

B-1 Voltage tests, except discharge resistor tests, shall be carried out with either an ac or dc source as specified in the relevant clauses. The source shall be adequate to maintain, over any specified test period, the test voltage required, subject to a tolerance of ± 2.5 percent, but ± 1.5 percent for the endurance test.

ac voltage tests shall be made using a 50 Hz frequency, as appropriate, the voltage waveform of which shall be sufficiently free from harmonics as to ensure that, when applied to the capacitor, the resulting current shall not exceed the value corresponding to a sinusoidal voltage waveform by more than 10 percent.

If desired, discharge resistors may be disconnected during voltage test between terminals.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc No.: ETD 23 (5881).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices:		*Telephones*
Central	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	2323 7617 2323 3841
Eastern	1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	SCO 335-336, Sector 34-A, CHANDIGARH 160022	260 3843 260 9285
Southern	C.I.T. Campus, IV Cross Road, CHENNAI 600113	2254 1216, 2254 1442 2254 2519, 2254 2315
Western	Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	2832 9295, 2832 7858 2832 7891, 2832 7892

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Published by BIS, New Delhi